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ELECTROCHEMICAL TREATMENT OF WATER
(56) Prior Art Documents
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43263/72 E04H 3/20
(57) Claim

1. An electrolytic chlorinator convection pump apparatus comprising:-

a hollow housing having an inlet port adjacent a lower portion of said housing and an outlet port adjacent an upper portion of said housing said inlet port and said outlet port being adapted for connection to respective apertures in a side wall of a container of water to be chlorinated; and

an electrode assembly comprising at least one anode and at least one cathode located within said housing, said chlorinator in use being positioned externally of a container of water to be chlorinated with said outlet port being located above said inlet port, said outlet port and inlet port being in fluid communication with water contained in said container, said water including a soluble chlorine ion containing electrolyte, said outlet port being located below an upper surface of the water in said container

whereby said housing is substantially filled with water, said electrode assembly being energizable by a source of electrical power to produce gaseous electrolysis products including hydrogen and chlorine gases on the electrode surfaces whereby gas bubbles released from the electrode surfaces cause by convection a flow of water from said container via the inlet port through the housing to the outlet port to pump freshly chlorinated water into the container.

12. A swimming pool including -

a hollow housing having an inlet port adjacent a lower portion of said housing and an outlet port adjacent an upper portion of said housing said inlet port and said outlet port being adapted for connection to respective apertures in a side wall of a container of water to be chlorinated; and

an electrode assembly comprising at least one anode and at least one cathode located within said housing, said chlorinator in use being positioned externally of a container of water to be chlorinated with said outlet port being located above said inlet port, said outlet port and inlet port being in fluid communication with water contained in said container, said water including a soluble chlorine ion containing electrolyte, said outlet port being located below an upper surface of the water in said container whereby said housing is substantially filled with water, said electrode assembly being energizable by a source of electrical power to produce gaseous electrolysis products

including hydrogen and chlorine gases on the electrode surfaces whereby gas bubbles released from the electrode surfaces cause by convection a flow of water from said container via the inlet port through the housing to the outlet port to pump freshly chlorinated water into the container.

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This document contains the amendments made under Section 49.

and is correct for printing.

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COMPLETE SPECIFICATION FOR THE INVENTION ENTITLED:

"METHOD AND APPARATUS FOR TREATMENT OF WATER"

The following statement is a full description of the invention including th best m thod f performing it kn wn to us:

This invention relates to an improved method and apparatus for treatment of water and in particular to chlorination of water.

Previously known electrolytic chlorinating devices for swimming pools have generally comprised electrodes situated within a tubular housing, the housing being provided at each end with fittings to enable the device to be connected directly into the filtration return line between the skimmer box and the filter pump. Although these devices are generally satisfactory in producing chlorine gas for swimming pool sanitization, they are, nevertheless, subject to a number of inherent disadvantages.

Within the environment of electrolytic cells of this kind, dissolved calcium salts in the pool water are plated out on the cathode as well as on other surfaces in the region of the cell. To maintain reasonable cell efficiency, it is necessary to clean the electrodes (usually expanded titanium mesh) by immersion in acid. This exercise requires the filter pump to be switched off and the cell to be disconnected from the filtration return line. Visual inspection of the electrodes is only possible when the device is removed from the return line and thus constant monitoring of chlorine levels in the pool water are required to gauge the operating efficiency of the cell.

Possibly the most serious disadvantage of electrolytic cells of this type is the fully enclosed nature of their installation. The cell relies on the current of water sweeping past the electrodes to remove the chlorine and hydrogen gas bubbles from the surface of the anode and cathode respectively. It is clear therefore that cells of this type are only effective when the filter pump is running. If the filter pump breaks down, or is removed for maintenance it is not possible to operate the electrolytic chlorinator.

A dangerous situation can occur if the water flow in the return line is stopped by pump failure or a blockage

in the line. Pockets of hydrogen and chlorine gases thus produced have been known to explosively recombine in the presence of the titanium electrodes which can act as a catalyst. Many chlorinating devices of this kind include a form of safety device which will deactivate the cell if the flow of water through the cell is interrupted. Additional safety devices however add to the expense of purchase, installation and maintenance of a pool chlorinator and their safety of operation depends on the reliability of the safety devices.

In Australian Patent Specification No. 43263/72 there is described an immersible electrode assembly comprising a hollow housing containing a pair of spaced electrodes. Towards the upper and lower ends of the housing there are a plurality of narrow apertures representing inlet and outlet ports. With the housing submerged and filled with swimming pool water containing sodium chloride electrolyte, it is alleged that gas bubbles produced at the electrodes cause by convection a flow of water through the housing to release freshly chlorinated water at the upper outlet ports.

At high voltage levels the device is ineffective as polarization on the electrode surfaces reduces the effective surface area of the electrodes and their gas output. Due to the combined effects of polarization and the closed nature of the container there is insufficient flow of electrolyte across the el rode surfaces to sweep the electrodes clear

of gas bubbles and thus maintain a high effective electrode surface area.

At lower voltage levels the rate of chlorine gas production is sufficiently low as to be ineffective in raising the chlorine concentration in a swimming pool to an effective level.

It is an aim of the present invention to provide an electrolytic pool chlorinating device which overcomes or alleviates the problems of prior art chlorinators.

is provided an electrolytic chlorinator convection pump apparatus comprising:-

a hollow housing having an inlet port adjacent a lower portion of said housing and an outlet port adjacent an upper portion of said housing said inlet port and said outlet port being adapted for connection to respective apertures in a side wall of a container of water to be chlorinated; and

an electrode assembly comprising at least one anode and at least one cathode located within said housing, said chlorinator in use being positioned externally of a container of water to be chlorinated with said outlet port being located above said inlet port, said outlet port and inlet port being in fluid communication with water contained in said container, said water including a soluble chlorine ion containing electrolyte, said outlet port being located below an upper surface of the water in said container whereby said housing is substantially filled with water, said electrode assembly being energizable by a source of electrical power to produce gaseous electrolysis products including hydrogen and chlorine gases on the electrode surfaces whereby gas bubbles released from the electrode surfaces cause by convection a flow of water from said container via the inlet port through the housing to the outlet port to pump freshly chlorinated water into the container.

According to yet another aspect of the invention there is provided a method of chlorinating a swimming pool comprising the steps of:-

locating an electrode assembly containing housing with an inlet port and an outlet port adjacent an outer surface of a wall of a swimming pool with said inlet port and said outlet port in fluid communication with respective apertures extending through said wall, said inlet port being located below said outlet port and said inlet and outlet ports in fluid communication with an aqueous electrolyte having chlorine ions contained in said swimming pool whereby said housing is substantially filled with said electrolyte; and

applying to said electrode assembly a source of electrical power sufficient to cause hydrogen gas to be produced at a cathode and chlorine gas to be produced at the anode whereby gas bubbles produced on the electrode assembly surfaces create a convection current in the electrolyte causing the electrolyte to flow via the inlet port through the housing to the outlet port to pump freshly chlorinated electrolyte into the swimming pool.

Preferred embodiments of the invention will now be described with reference to the accompanying drawings in which:

FIG. 1 illustrates a partial cross section of an

installation of one embodiment of the invention as a swimming pool chlorinator.

FIG. 2 illustrates a schematic plan view of the type of installation illustrated in FIG. 1.

FIG. 3 illustrates an alternative embodiment of the cell configuration shown in FIG. 1.

FIG. 4 illustrates a further embodiment of the invention.

In FIG. 1, the electrolytic cell is so constructed and arranged to act as a circulating "pump".

The cell is constructed as a generally U-shaped tubular container 1 with an inlet port 2 and an outlet port 3. A gas venting port 4 is formed as an extension to one leg 1a of the U-shaped container. The electrode assembly 5 may comprise spaced elongate plates of a suitable metal but preferably comprises concentric cylinders of expanded titanium mesh. If required, an external shroud may be provided to act as a means for locating the electrode assembly at a desired position within the leg 1a of container 1. For this purpose, an inwardly projecting abutment may be arranged within the leg 1a to engage the electrode assembly or the outer shroud. Electrical leads 6 are led up through the gas venting port for connection to electrical control device 7 which suitably is remotely located, say on the outer wall of a house, inside a pool, cabana etc.

The electrolytic cell container 1 is preferably located below a ground surface 8 at a depth lower than the water level 9. Most preferably the upper portion of the container 1 is situated at a level 10 just below the bottom of the pool skimmer 11 (the lowest operating level of the pool filter). The container 1 is connected to the interior of the pool by pipes passing through the pool wall and terminating at an "eyeball" outlet 12. An inlet pipe 13 is shown, the outlet pipe (not shown) being situated at the

same level but spaced therefrom.

FIG. 2 illustrates a schematic plan view of the installation of FIG. 1. Inlet pipe 13 is connected at one end to an "eyeball" outlet 12 and at its other end to the inlet port 2 of container 1. Similarly outlet pipe 14 connects at one end to "eyeball" 15 in pool 16 and at its other end to outlet port 3. Electrical control box 7 is shown attached to the outside wall 17 of a structure.

FIG. 3 illustrates an alternative embodiment of the U-shaped container shown in FIG. 1. The container comprises a generally cylindrical body 18 with a tapered or conical top 19. An inlet port 20 communicates with the interior of the container and outlet port 21 is formed as a "T"-junction in gas venting port 22.

FIG. 4 illustrates yet another embodiment of the invention with the electrolysis cell shown enlarged relative to the pool wall. The cell comprises a container 23 divided into a cathode compartment 24 and an anode compartment 25 by a semi-permeable membrane 26. Anode 28 and cathode 27 respectively are preferably comprised of expanded titanium mesh and expanded titanium mesh plated with a platinum-iridium alloy. Conductors 29 are connected to a suitably controlled source of electrical power. The container 23 has a removable cover plate 30 and venting ports 31 are provided to prevent pressure build-up from excess gas production. The inlet port 32 and outlet port 33 are in fluid communication with the interior of swimming pool 40 as shown in FIG. 1 except that pool inlet pipe 34 is positioned slightly above pool outlet pipe 35. The container is positioned relative to the level 36 of pool water such that the level 37 of liquid in the container 23 is slightly below the top of the semi-permeable membrane. In this manner, a weir is formed over which the dense chlorine gas 38 flows for absorption in the catholyte. A perforated pipe 39 is positioned in the cathode compartment adjacent the cathode

surface to remove NaOH formed at the cathode surface.

The operation of the embodiments of FIGS. 1-3 will now be described. Under normal conditions, electrolyte containing water will fill the container, the inlet and outlet pipes and partially fill the gas venting tube to a level coincident with the level of water in the pool. When the electrode assembly is energized under appropriate polarizing conditions, chlorine gas produced at the anode will dissolve in the surrounding water and hydrogen bubbles commence to flow upwardly into the gas venting port. As the portion of liquid surrounding the electrode assembly contains a high concentration of hydrogen gas bubbles, the bulk density of this portion of liquid is less than that of the surrounding liquid. The less dense portion of liquid commences to flow upwardly, pushing the liquid in the outlet port and outlet pipe before it. Simultaneously liquid flows in from the inlet tube and inlet port to the bottom of the container. It can be seen that through a combination of lowered bulk density of liquid and the "sweeping" effect of the hydrogen bubbles, a convection current is set up to continuously bring fresh electrolyte into the region of the electrode assembly. In this manner, as with the earlier mentioned embodiment of the invention, the chlorinating device is completely independent of the filter pump liquid circulation path. Free hydrogen gas passes up the gas venting tube and is released safely to atmosphere without the risk of pressure buildup. Although the gas venting tube is preferred it is not essential as the gas bubbles could be caused to flow into the pool via the outlet tube.

To clean the electrode assembly, it is simply withdrawn through the gas venting tube, cleaned and then lowered into place.

An electrolyte comprising sodium chloride and a small amount of hydrochloric acid is dissolved in the water

contained in a swimming pool. A preferred concentration of chlorine is in the range of 0.3 - 1.0% by weight of NaCl, the optimum concentration for effectiveness and swimmer comfort being 0.7% by weight.

The voltage selector is switched to a preferred operating voltage of 10.5 volts and a current density of approximately 80 amp/sq. metre.

When the electrode assembly is energized under the above conditions, chlorine gas is produced at the anode as the main product and a small amount of hydrogen gas is produced at the cathode. The gas bubbles rising from the electrode surfaces cause a flow of electrolyte containing water over the electrodes thus replenishing locally consumed chloride ions. This fluid flow also prevents a rise in pH in the water immediately adjacent the electrodes. A high local pH is known to enhance calcium precipitation.

The operation of the embodiment of FIG. 4 differs slightly from that of FIGS. 1-3. The semi-permeable membrane divides the cell into separate anode and cathode compartments. Solid sodium chloride is added to the anode compartment to form a concentrated solution with excess solid material at the bottom of the cell. Chlorine gas produced in the anode compartment 25 collects above the surface of the anolyte and being denser than air, fills the space above the catholyte until it reaches the "weir" level at the top of the semi-permeable membrane. The chlorine gas then overflows into the cathode compartment where it contacts, and is absorbed into, the surface of the catholyte.

Sodium ions produced in the anode compartment migrate through the semi-permeable membrane for combination with hydroxide ions formed at the cathode. Excess sodium hydroxide is removed from the region of the cathode via a perforated pipe connected to a low volume pump. In this

manner it is possible to exercise a far greater degree of control over the pH in the pool water.

The hydrogen bubble "gas pump" operation for circulation of water through the cathode compartment is substantially identical to that of the embodiments of FIGS. 1-3. To further assist in the "convection" current, the pool inlet pipe 34 may be placed slightly above the pool outlet pipe 35 as shown in FIG. 4. Alternatively pipes 34 and 35 may have a slight upward incline between the cell container and the outlets into the pool.

Swimming pool chlorinators or water treatment devices of the kind referred to above have been found to be more efficient than other chlorinating systems i.e. prior art salt water chlorinators or chemical chlorination systems, in that if run continuously much lower free chlorine is required to keep a pool sparkling clean and sanitized.

In practice it is preferred to run the electrolysis device continuously and independently of the filter cycle although with suitable timing devices the apparatus could be run intermittently or in concert with the filter pump. The advantage of operating the device continuously compared with prior devices (which operate for say eight hours each day when the filter pump is operating) is that a much lower operating current is required to produce the same amount of free chlorine, i.e. 10 amps compared with 30 amps in prior art devices.

Further advantages accruing from the present invention will be readily obvious to a skilled addressee. For example, ready access to the electrode assembly door enables ready inspection and cleaning if required. In addition, the operation of the device independently of the filter pump enables it to be operated for prolonged periods without attention when a pool owner goes on holiday. Under conditions of little or no use of a swimming pool, e.g. in winter or when the pool owner is on

holiday, the rate of production of chlorine at the electrodes can be reduced to an effective level by lowering the operating voltage to a preselected value.

Where additional chlorine production is required the operating voltage can be increased until the chlorine level in the pool water has reached a desired level. Typically effective free chlorine levels of a continuously operated chlorinator according to the invention are in the region of 0.2 - 0.5 ppm whereas conventional intermittent chlorination systems require 1.5 - 3.0 ppm. A further advantage accruing from the invention is that there is effectively no algae growth in the pool water as with prior art systems between intermittent chlorination cycles. Accordingly, the need for filter backwash is substantially reduced.

Other modifications to the embodiments of FIGS. 1-3 include means to introduce salt directly into the container in the region of the electrode assembly. The container may be modified to enable a large quantity of salt to be retained in the lower part of the container body and the salt may be introduced directly via the gas venting port or via a separate access means. If required, a heating element could be incorporated in container of the kind described above to obtain a pool heating arrangement utilizing a convection current for circulation.

It is to be further understood that the apparatus according to the invention is not limited to chlorination of swimming pool water but is applicable to treatment of a body of water or the like by suitable selection electrolytes, operating voltages and current densities etc. to produce a selected electrolysis product.

It will be readily apparent to a skilled addressee that many modifications and variations may be made to the invention without departing from the spirit and scope of the invention.

The claims defining the invention are as follows:

1. An electrolytic chlorinator convection pump apparatus comprising:-

a hollow housing having an inlet port adjacent a lower portion of said housing and an outlet port adjacent an upper portion of said housing said inlet port and said outlet port being adapted for connection to respective apertures in a side wall of a container of water to be chlorinated; and

an electrode assembly comprising at least one anode and at least one cathode located within said housing, said chlorinator in use being positioned externally of a container of water to be chlorinated with said outlet port being located above said inlet port, said outlet port and inlet port being in fluid communication with water contained in said container, said water including a soluble chlorine ion containing electrolyte, said outlet port being located below an upper surface of the water in said container whereby said housing is substantially filled with water, said electrode assembly being energizable by a source of electrical power to produce gaseous electrolysis products including hydrogen and chlorine gases on the electrode surfaces whereby gas bubbles released from the electrode surfaces cause by convection a flow of water from said container via the inlet port through the housing to the outlet port to pump freshly chlorinated water into the container.

2. An electrolytic chlorinator convection pump as claimed in claim 1 including a gas venting port adjacent an upper end thereof.

3. An electrolytic chlorinator convection pump as claimed in claim 1 or claim 2 wherein the electrode assembly is removable from said housing via an opening in the top of said housing.

4. An electrolytic chlorinator convection pump as claimed in any one of claims 1-3 wherein said housing includes a removable cover at an upper end thereof.

5. An electrolytic chlorinator convection pump as claimed in any one of claims 1-4 wherein the electrode assembly comprises expanded titanium mesh.

6. An electrolytic chlorinator convection pump as claimed in claim 5 wherein at least the anode comprises expanded titanium mesh having a surface coating of a platinum-iridium alloy.

7. An electrolytic chlorinator convection pump as claimed in any one of claims 1-6 comprising a substantially cylindrical housing.

8. An electrolytic chlorinator convection pump substantially as hereinbefore described.

9. An electrolytic chlorinator convection pump substantially as hereinbefore described with reference to the accompanying drawings.

10. A method of chlorinating swimming pool water comprising the steps of:-

locating an electrode assembly containing housing with an inlet port and an outlet port adjacent an outer surface of a wall of a swimming pool with said inlet port and said outlet port in fluid communication with respective apertures extending through said wall, said inlet port being located below said outlet port and said inlet and outlet ports in fluid communication with an aqueous electrolyte having chlorine ions contained in said swimming pool whereby said housing is substantially filled with said electrolyte; and

applying to said electrode assembly a source of electrical power sufficient to cause hydrogen gas to be produced at a cathode and chlorine gas to be produced at the anode whereby gas bubbles produced on the electrode assembly surfaces create a convection current in the electrolyte causing the electrolyte to flow via the inlet port through the housing to the outlet port to pump freshly chlorinated electrolyte into the swimming pool.

11. A method as claimed in claim 10 wherein an electrolytic convection chlorinator according to any one of claims 1-9 is employed.

12. A swimming pool including a chlorinator, said chlorinator comprising:-

a hollow housing having an inlet port adjacent a lower portion of said housing and an outlet port adjacent an upper portion of said housing said inlet port and said outlet port being in fluid communication with respective apertures in a side wall of said swimming pool; and,

an electrode assembly comprising at least one anode and at least one cathode located within said housing, said chlorinator in use being positioned externally of said swimming pool with said outlet port being located above said inlet port, said outlet port and inlet port being in fluid communication with water contained in said swimming pool, said water including a soluble chlorine ion containing electrolyte, said outlet port being located below an upper surface of the water in said swimming pool whereby said housing is substantially filled with water, said electrode assembly being energizable by a source of electrical power to produce gaseous electrolysis products including hydrogen and chlorine gases on the electrode surfaces whereby gas bubbles released from the electrode surfaces cause by convection a flow of water from said swimming pool via the inlet port through the housing to the outlet port to pump freshly chlorinated water into the swimming pool.

13. A swimming pool including an electrolytic chlorinator convection pump apparatus according to any one of claims 2-9.

14. A swimming pool including an electrolytic chlorinator convection pump apparatus substantially as hereinbefore described.

DATED this Seventh day of July, 1987.

SAL-CHLOR PTY. LTD.
by its Patent Attorneys
G.R. CULLEN & COMPANY.

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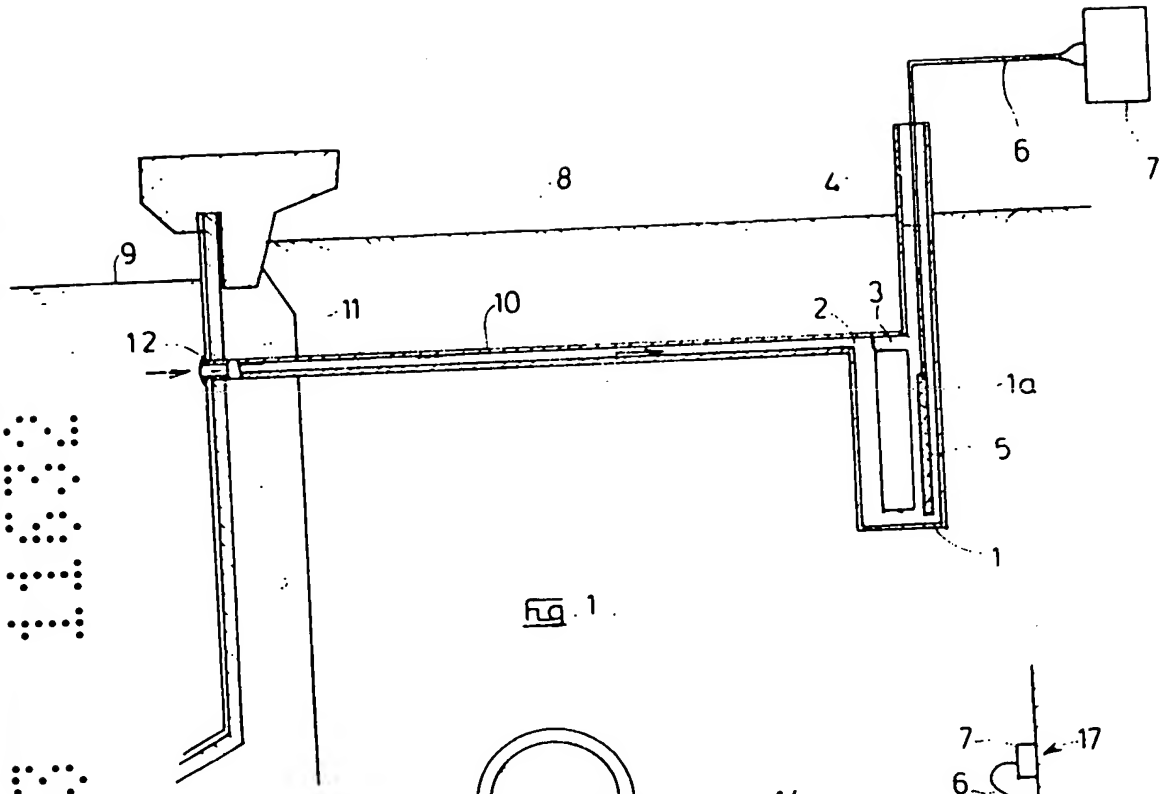

fig. 1

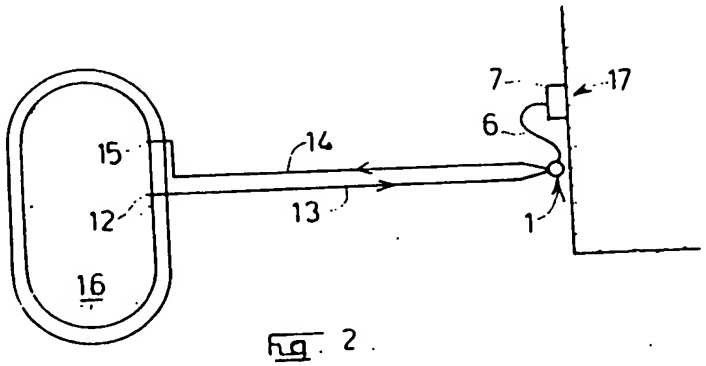

fig. 2

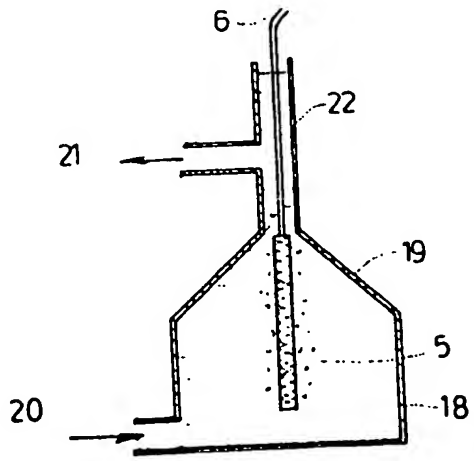

fig. 3

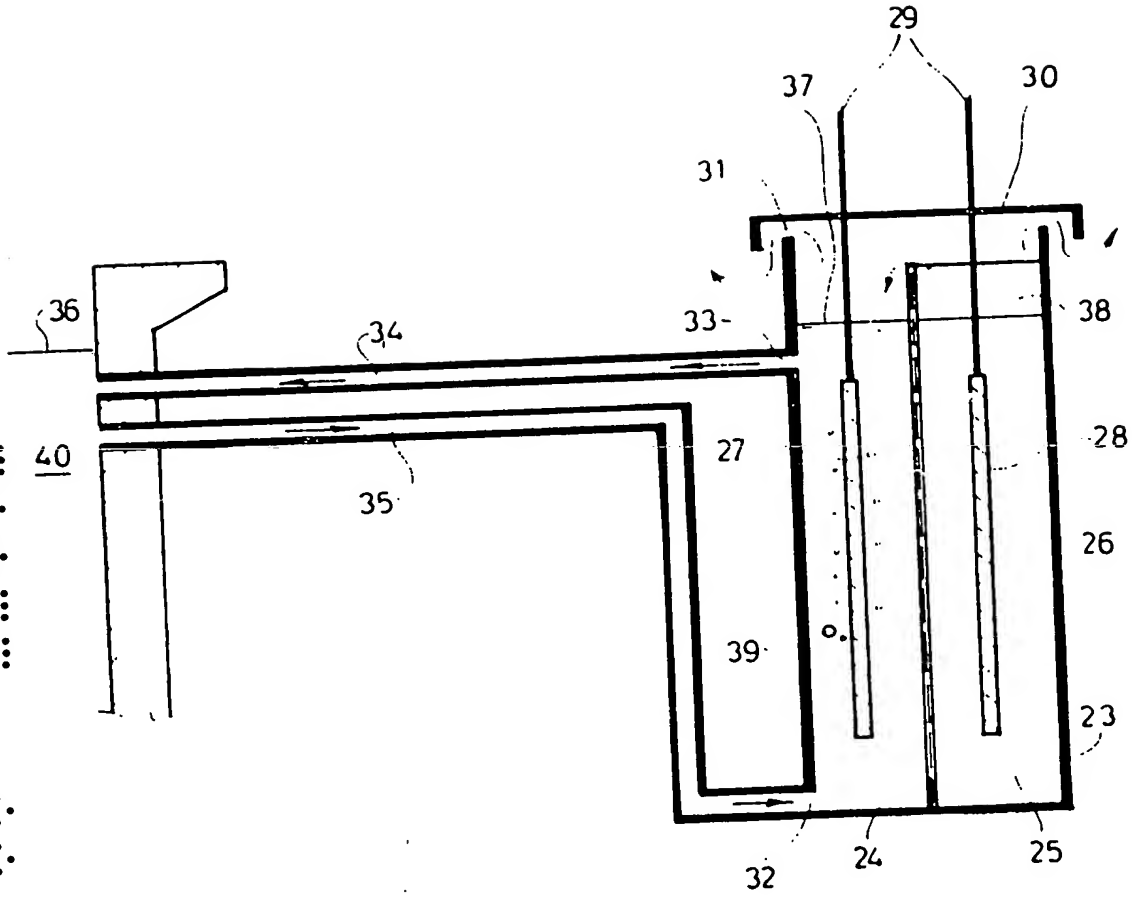

Fig 4